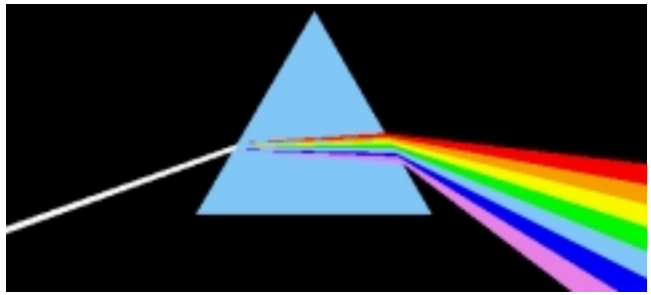
Wavelength Division Multiplexing (WDM) Technology for Naval Air Applications



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DARPA/MTO, WDM for Military Platforms Workshop held in McLean, VA on April 18-19, 2000, The original document contains color images.

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Aerospace Photonics

- Despite Significant Commercial and DARPA Funding of WDM Technology, the Technology Has Yet to Impact Naval Aerospace Platforms.
- Affordability, Environmental Compatibility, and Technology Readiness Level Remain Impediments.
- Directed Technology Maturation at the Component, Packaging, and System Level Are Required.
- Broad Application to fighter, transport, ASW, AEW, VSTOL, UAV/UCAV, Rotary Wing, and Space Platforms.
- Many Common Issues with FTTH and FTTD

AEROSPACE PLATFORM INTERCONNECTS

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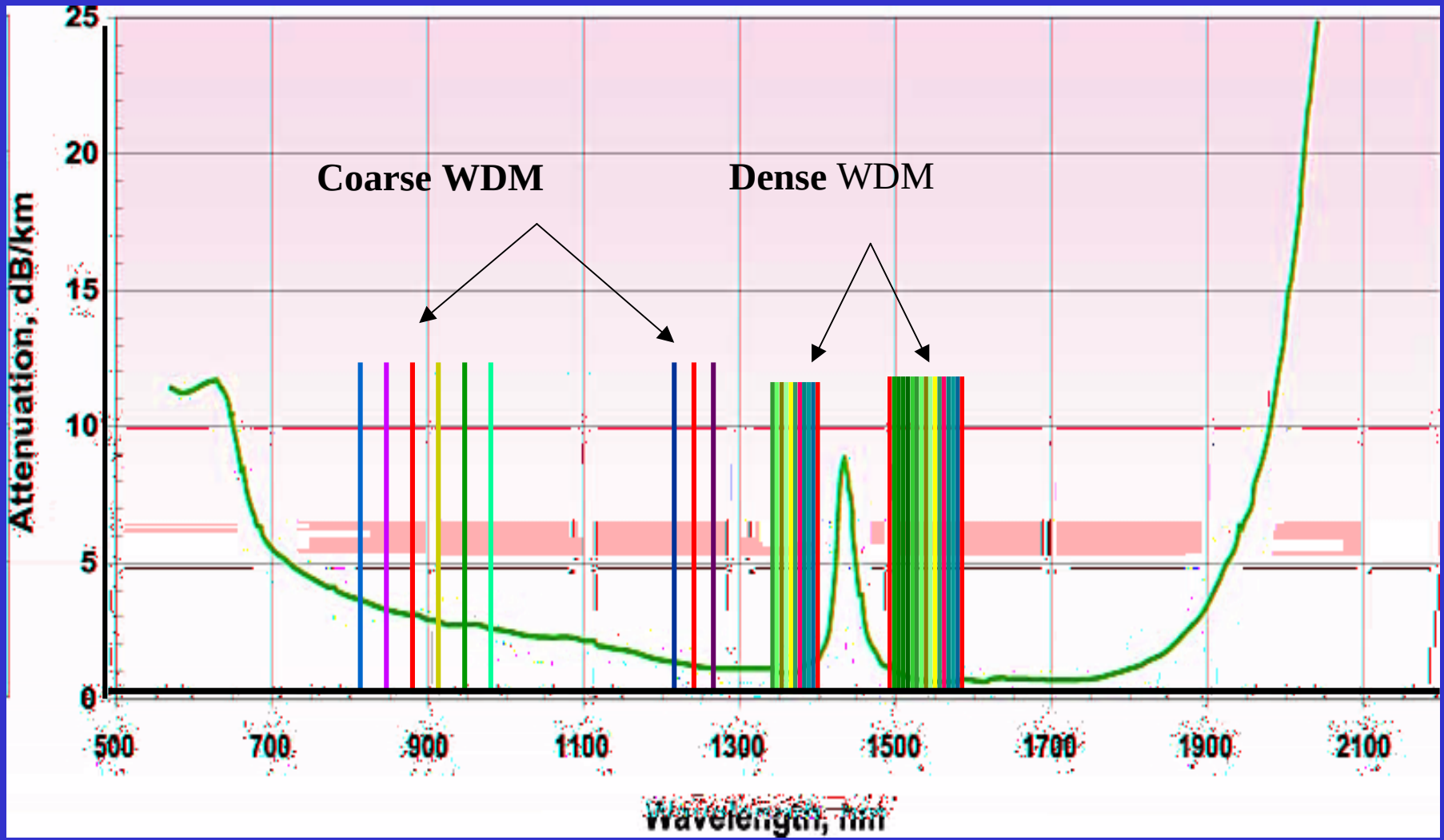
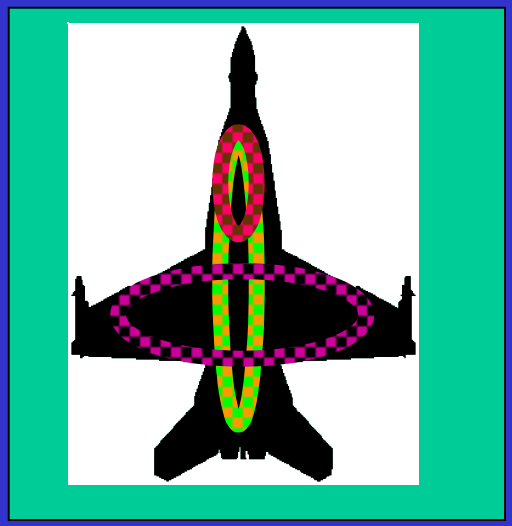
PLATFORM/SYSTEM		FIBER SIZE								CABLE CONSTRUCTION				CONNNECTORS						
		100/140/172 - GI	100/140/170 - GI	62.5/125 - GI	200/208 HCS - SI	100/140 -GI (NON-POLYIMIDE)	200/300 - GI(EUROPE)	200/280 - SI(EUROPE)	Single Mode	SIMPLEX	CIRCULAR MULTI - CABLE	RIBBON	BLOWN	SMA	HA	ST	Lensed	38999 TYPE	SPECIAL	MT
USA	F-22	X									X							X		
	RAH-66	X									X							X		
	F/A 18	X									X							X		
	F/A 18 E/F	X							X		X							X		
	FOIS	X								X								X		
	AV-8B	X								X	X							X		
	F15 Towed Decoy								X	X	X								X	
	T45																			
	C-130	X		X							X					X		X		
	AWACS (707)			X						X						X				
	BOEING 777	X									X						X	X		
SPACE	SSF		X							X	X							X	X	
	SATELLITE					X				X				X				X		
NON-US	EUROFIGHTER Data bus							X		X					X					
	HF 9000 SYSTEM				X		X	X		X				X						
	EUROFIGHTER towed decoy								X	X										
	SKS600 AIRSHIP							X		X								X		
	SEA HARRIER						X			X				X				X		
	RAFALE							X		X										
	MIRAGE 2000																			
	TIARA							X		X										
	EH101-Mk3 Merlin							X												
	CHINOOK HC Mk3							X												
	E-3D SENTRY							X							X					
	SEA KING Mk3a							X												
	NIMROD 2000			X						X						X				
	LYNX (Export)						X	X		X				X						
	Gripen																			
	EUROCOPTER							X												
	A340/600 Taxi Aid			X										X						
	A340/500 IFES			X							X						X	X		

WDM Spectrum and Wavelength Selection

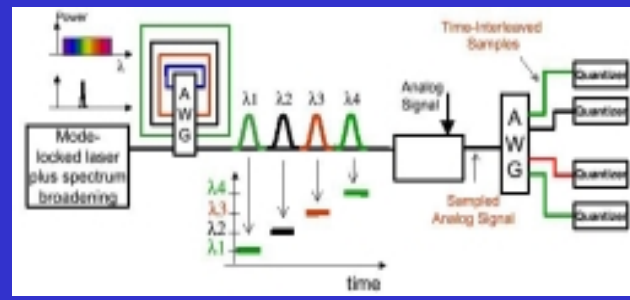


Potential WDM Applications

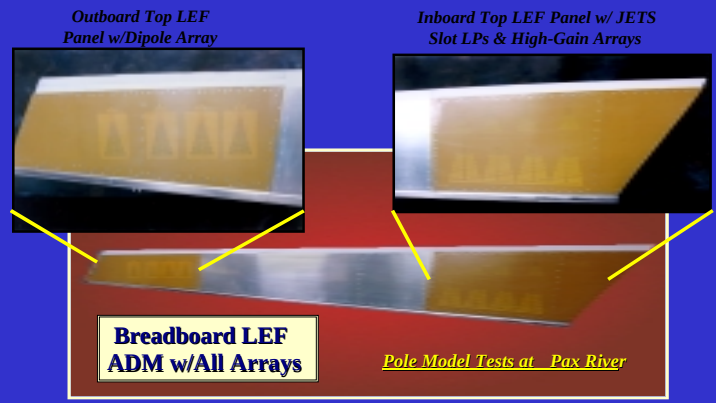


Networks for Aircraft/ UAV Avionics & VMS

Free Space Interconnects



True Time Delay A/D Conversion



Smart Skins/Structures Interconnect and Diagnostics

Missile and Decoy Interfaces

Computer Interconnects

Current NAVAIR WDM Developments

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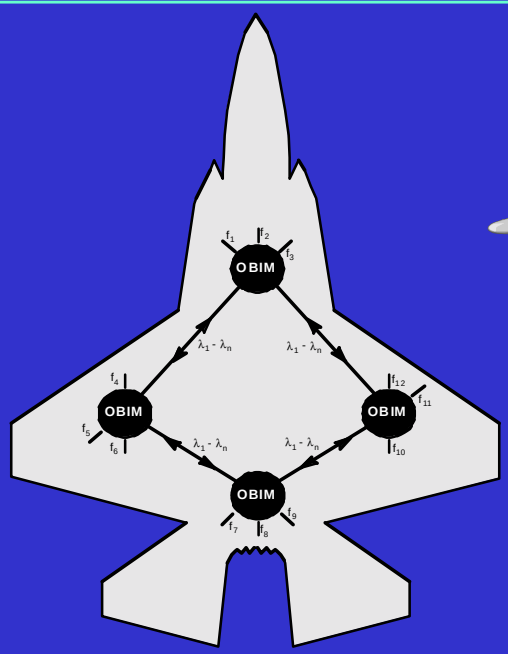
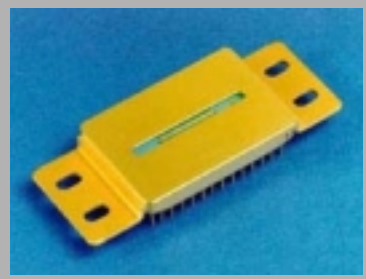
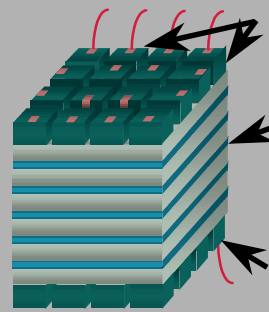
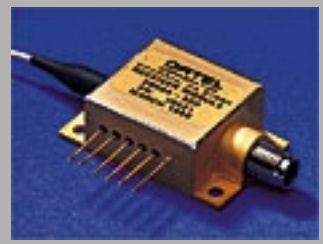


FAST WDM/SCM Network Development

P-3 "Hairy Buffalo" Demonstration







Broadband Component Developments

Required Component Maturation

- High Density Single Mode Cable Plant
  - Small Footprint Single Channel and Array Connectors
  - Rugged Ribbon and Single Channel Cables
  - Installation and Maintenance Tools and Test Equipment
- Optical Backplane Technology
  - Media and Connectors
- Tunable and Multi-Wavelength Lasers & Filters
  - Broad Spectrum for Coarse and Dense WDM
  - Efficient Pump Lasers for all Bands
  - Rapid Continuously Tunable Lasers and Filters

Required Component Maturation

- Planar Wavelength Selective Couplers and Array Waveguides
- Affordable Compact Fiber, Glass, and Waveguide Amplification - Multi-Band/Broadband.
- Broadband "Smart Pixel" Detectors.
- High Speed Modulators and "All Optical" Switching
- Embedded Structural Diagnostics
  - Bragg Grating and Fabry Perot Micro-sensors
  - Integrated WDM Sensor Interface

Packaging/Connector Issues

- Prefer Hermetic, Connectorized, Low profile Device and Component Packages.
- Non-TE cooling preferred.
- Transceivers Should include Built-in-Test Features
  - Power Monitors
  - Simple Threshold Logic
  - Switching Capability
- Small Footprint Ferrules and Connector Backshells
- Designed to withstand Temperature, Shock, Vibration

SYSTEM DEMONSTRATIONS

- BROADBAND MIXED SIGNAL WDM/SCM NETWORK WITH MULTI-CHANNEL DIGITAL, RF, AND FLIGHT CRITICAL DATA
- VCSEL BASED TRANSMISSION OF PARALLEL DATA VIA WDM IN AN OPTICAL BACKPLANE INTERCONNECT
- MIL-STD 1760 WDM MULTI-CHANNEL WEAPONS DATA LINK
- FREE SPACE SMART STRUCTURE SENSOR NETWORK
- WDM BASED A/D AND TRUE TIME DELAY IN BROADBAND AIRBORNE PHASED ARRAY

Summary

- Internet is driving Commercial WDM Technology
- Aerospace Environment is the Challenge
- COTS Components Must be Designed, Packaged or Screened to Operate in this Harsh Environment
- Affordability Remains an Issue with Low Volume
- Systems Requirements are still unique:
  - Latency, Determinism, Throughput, RF Frequency Bands, Fault Tolerance, System and Structural Health Monitoring.
- WDM is a High Payoff Technology